GEOLOGY DEPT.
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CONTRIBUTIONS

FROM THE

CUSHMAN LABORATORY

FOR

FORAMINIFERAL RESEARCH

VOLUME 10, PART 3

SEPTEMBER, 1934

CONTENTS

SHARON, MASSACHUSETTS, U. S. A.
1934

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CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

145. EOCENE FORAMINIFERA OF THE POWAY CONGLOMERATE OF CALIFORNIA

By J. A. CUSHMAN and A. N. DUSENBURY, JR.

The material which forms the subject of this paper was collected by H. G. Schenck in December, 1931, from a gravel pit of the H. G. Fenton Material Co., situated a quarter of a mile up Murray Canyon from the road along the north side of Mission Valley. This locality (Leland Stanford Jr. Univ. Loc. 1150) is approximately four and a half miles north of San Diego, California. The rock formation at this place is the Poway conglomerate, a local formation consisting of unfossiliferous river gravel and alluvial fan deposits inland, and of a deltoid marine conglomerate containing fossiliferous lenses of gray shale and fine sandstone seaward. Our material comes from one of these lenses, a large one of buff, fine-grained, shaly sandstone, where it was found in association with a few poorly preserved macrofossils of Tejon age, mostly molds and casts.

The Poway conglomerate was considered to be of basal Pliocene age, until M. A. Hanna published a pair of papers (Geology of the La Jolla Quadrangle, California; Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 16, No. 7, 1926, pp. 187-246; and An Eocene Invertebrate Fauna from the La Jolla Quadrangle, California; loc. cit., No. 8, 1927, pp. 247-398) clearly proving it to be Eocene, probably the equivalent of the type Tejon. Our results confirm Hanna's conclusion, and enable us to correlate our faunule with fair certainty with the Upper Claiborne (Auversian) of the Gulf Coast of the United States.

The junior author has previously summarized in greater detail the geology of the Poway formation in a paper (A Faunule from the Poway Conglomerate, Upper Middle Eocene of San Diego

County, California; Micropal. Bull., vol. 3, No. 3, 1932, pp. 84-95) which includes a list of the macrofossils and a list of tentative designations of the microfossils. The object of the present paper is to furnish final corrected designations for the many species of foraminifera, and to describe and illustrate those species.

All types have been deposited at Stanford University. Duplicate material, in so far as possible, has been filed at the Cushman Laboratory for Foraminiferal Research.

The foraminiferal fauna of the Poway conglomerate contains a very considerable portion of Lagenidae. This family is noted for the great amount of variation in its species and the consequent amount of difficulty in determining the range of specific characters. Microspheric and megalospheric forms in the same species often differ widely, as do also the early and later stages. Many species of *Robulus*, for example, may have comparatively few chambers in a coil in the young stage of the megalospheric form, and yet in the adult may increase the number of chambers to double the number in the earlier stage. The angle of the sutures is also a character that varies somewhat with age, and altogether the group is a difficult one. In the Lagenidae of this collection from the Poway there is a distinct relationship apparent with the species described by Stache from the Eocene of New Zealand. The majority of the Poway species were originally described from the Middle and Upper Eocene of the Gulf and Pacific Coasts of the United States and Mexico. The two Buliminas were described from the Miocene of Japan. *Globigerina cretacea* and *Gümbelina striata* are probably reworked from the Cretaceous, although C. C. Church tells us that the single small collection which he made from the Cretaceous of the La Jolla district does not contain either of these genera.

We have omitted illustrations of several of the better known species, and have omitted entirely any mention of a number of obscure species represented by rare, poorly preserved specimens. Most of the species are illustrated here, but it is often impossible to show with a few figures the variations in the different forms or the changes that occur between the youthful and mature stages.

ROBULUS LIMBOSUS (Reuss), var. HOCKLEYENSIS (Cushman and Applin) (Pl. 7, fig. 1)

Cristellaria limbosa (REUSS), var. *hockleyensis* CUSHMAN and APPLIN, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 171, pl. 8, figs. 3, 4.—ELLISOR, l. c., vol. 17, 1933, pl. 1, figs. 11 *a*, *b*.

Specimens are very rare in the Poway, but they closely resemble the smaller specimens from the Upper Eocene, Jackson formation, of Texas.

ROBULUS ARTICULATUS (Reuss), var. TEXANUS (Cushman and Applin) (Pl. 7, figs. 2, 3)

Cristellaria articulata REUSS, var. *texana* CUSHMAN and APPLIN, l. c., vol. 10, 1926, p. 170, pl. 8, figs. 1, 2.—ELLISOR, l. c., vol. 17, 1933, pl. 2, fig. 3.

There are numerous specimens showing the usual range of variation in this form. They are close to the variety known from the Upper Eocene of Texas. The figured specimens are immature.

ROBULUS GYROSCALPRUM (Stache) (Pl. 7, figs. 4 a, b)

Cristellaria gyroscalprum STACHE, *Novara* Exped., Geol., vol. 1, 1864, p. 243, pl. 23, figs. 22 *a*, *b*.

Robulus gyroscalprum WEINZIERL and APPLIN, Journ. Pal., vol. 3, 1929, p. 394.

In its general appearance and the angle of the sutures the Poway form closely resembles Stache's species from the Eocene of New Zealand. It is also close to the form recorded from the Eocene of Texas as *Cristellaria alato-limbata* (Gümbel) by Cushman and Applin (Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 171, pl. 8, fig. 8).

ROBULUS ANTIPODUM (Stache) (Pl. 7, figs. 5 a, b)

Robulina cultrata (D'ORBIGNY), var. *antipodum* STACHE, *Novara* Exped., Geol., vol. 1, 1864, p. 251, pl. 23, figs. 30 *a*, *b*.

This form closely resembles the preceding, and they may perhaps belong to a single species. The slight difference in the angle of the sutures and relative size of the umbonal region correspond to the difference shown by Stache in his original figures.

ROBULUS ROTULUS (Stache) (Pl. 7, figs. 6 a, b)

Cristellaria rotula STACHE, *Novara* Exped., Geol., vol. 1, 1864, p. 233, pl. 23, figs. 12 *a*, *b*.

There are a number of small specimens which resemble Stache's species described from the Eocene of New Zealand. They may possibly be young stages of some of the preceding species, particularly the form here referred to *R. antipodum* (Stache).

LENTICULINA (?) CONVERGENS (Bornemann) (Pl. 7, figs. 7 a, b)

Cristellaria convergens BORNEMANN, Zeitschr. deutsch. geol. Ges., vol. 7, 1855, p. 327, pl. 13, fig. 16.

The figured specimen shows the character of a form found in the Poway. The apertural face is more or less rounded, and a robuline slit may be distinct, indistinct, or more often lacking.

VAGINULINA WRIGHTI Cole (?) (Pl. 7, figs. 8 a, b)

Vaginulina wrighti COLE, Bull. Amer. Pal., vol. 14, No. 51, 1927, p. 21, pl. 3, fig. 13.

Like others of this group, our Poway specimens are extremely variable. They resemble the form described by Cole from the Eocene, Guayabal formation, of Mexico, particularly in the number of the chambers and the angle of the sutures.

VAGINULINA COSTIFERA Cole (Pl. 7, fig. 9)

Vaginulina costifera COLE, l. c., 1927, p. 20, pl. 2, fig. 15.

There is a single specimen in our Poway material that strongly resembles the species described by Cole from the Guayabal formation.

DENTALINA OBLIQUISUTURATA Stache (Pl. 7, figs. 22-25)

Dentalina obliquisuturata STACHE, *Novara* Exped., Geol., vol. 1, 1864, p. 207, pl. 22, fig. 36.

Stache's figure of his Eocene species from New Zealand very closely resembles the Poway forms which are here figured. The sutures are very strongly oblique, but vary considerably. In the adult the chambers become much more inflated, and the sutures less strongly oblique.

DENTALINA COLEI Cushman and Dusenbury, n. sp. (Pl. 7, figs. 10-12)

Vaginulina legumen (LINNÉ), var. *elegans* COLE (not D'ORBIGNY), Bull. Amer. Pal., vol. 14, No. 51, 1927, p. 21, pl. 3, figs. 10, 11.

The type figure of *Nautilus legumen* Linné in Plancus and d'Orbigny's figures of *Vaginulina legumen* and *V. elegans* published posthumously by Fornasini (Mem. R. Accad. Istit. Bologna, ser. 5, vol. 10, 1902, pp. 38, 49, text figs. 32, 33) all depict rather compressed Recent forms with strongly elevated sutures. The Eocene form to which this name has been assigned has its sutures flush with the surface, and is compressed only in the first

few chambers, a characteristic which it has in common with several other species which are customarily referred to *Dentalina*. The few Poway specimens, mostly incomplete, seem especially close to those figured by Cole from the Eocene, Guayabal formation, of Mexico.

Holotype from the Eocene, Poway conglomerate of Murray Canyon, La Jolla Quadrangle, San Diego County, California.

DENTALINA CONSOBRINA d'Orbigny (?) (Pl. 7, figs. 13-15)

Dentalina consobrina D'ORBIGNY, Foram. Foss. Bass. Tert. Vienne, 1846, p. 46, pl. 2, figs. 1-3.

There is a wide range of forms which are usually included under this name. The megalospheric form is more curved, with the chambers usually shorter in the earlier portion. It has a large bulbous proloculum, often with a basal spine, and the chambers are much more irregular. In the adult the test is gently curved, the chambers elongate and somewhat swollen in the median portion. Similar forms of Eocene age are recorded by Cole from Mexico, Cushman and Hanna from California, and Hantken from Hungary.

DENTALINA VAGINA Stache (?) (Pl. 7, fig. 16)

Dentalina vagina STACHE, *Novara* Exped., Geol., vol. 1, 1864, p. 206, pl. 22, fig. 34.

Some of the Poway specimens strongly resemble Stache's species from the Eocene of New Zealand. Most of them are broken, the figured one being the most nearly complete of any.

DENTALINA SUBSTRIGATA (Stache) (Pl. 7, figs. 17-19)

Nodosaria substrigata STACHE, *Novara* Exped., Geol., vol. 1, 1864, p. 196, pl. 22, figs. 22 *a-c*.

Our specimens are probably nearer to those described and figured from the Eocene of New Zealand than to any others. In the microspheric form the test is tapering and distinctly curved, while in the megalospheric form the proloculum is larger, and there are fewer chambers forming a less curved test, although the sutures are sufficiently oblique to prevent confusion with the somewhat similar *Nodosaria latejugata* Gümbel. Both microspheric and megalospheric forms of our specimens possess a large basal spine.

DENTALINA CAPITATA (Boll) (?) (Pl. 7, fig. 20)

Nodosaria capitata BOLL, Geogn. deutsch. Ostseelander, 1846, p. 177, pl. 2, fig. 13.

Dentalina capitata HANTKEN, A magy. kir. földt. int. évkön., vol. 4, 1875 (1876), p. 29, pl. 3, fig. 16; Mitth. Jahrb. ungar. geol. Anstalt, vol. 4, 1875 (1881), p. 35, pl. 3, fig. 16.

There are several broken specimens in our Poway material which consist of subglobose chambers with the basal half costate. They are very similar to those figured by Hantken from the "*Clavulina*-szaboi" beds of Hungary.

NODOSARIA EWALDI Reuss (Pl. 7, fig. 21)

Nodosaria ewaldi REUSS, Zeitschr. deutsch. geol. Ges., vol. 3, 1851, p. 58, pl. 3, fig. 2.

A single specimen from the Poway has only three chambers, but very strongly suggests this species.

EXPLANATION OF PLATE 7

FIG. 1. *Robulus limbosus* (Reuss), var. *hockleyensis* (Cushman and Applin). × 50.

FIGS. 2, 3. *Robulus articulatus* (Reuss), var. *texanus* (Cushman and Applin). × 35. *a*, *a*, side views; *b*, *b*, apertural views.

FIGS. 4 *a*, *b*. *Robulus gyroscalprum* (Stache). × 35. *a*, side view; *b*, apertural view.

FIGS. 5 *a*, *b*. *Robulus antipodum* (Stache). × 35. *a*, side view; *b*, apertural view.

FIGS. 6 *a*, *b*. *Robulus rotulus* (Stache). × 35. *a*, side view; *b*, apertural view.

FIGS. 7 *a*, *b*. *Lenticulina* (?) *convergens* (Bornemann). × 35. *a*, side view; *b*, apertural view.

FIGS. 8 *a*, *b*. *Vaginulina wrighti* Cole (?). × 35. *a*, side view; *b*, apertural view.

FIG. 9. *Vaginulina costifera* Cole. × 35.

FIGS. 10–12. *Dentalina colei* Cushman and Dusenbury, n. sp. Figs. 10, 11, × 30; 12, × 50. Fig. 11, Holotype.

FIGS. 13–15. *Dentalina consobrina* d'Orbigny (?). × 30.

FIG. 16. *Dentalina vagina* Stache (?). ×30.

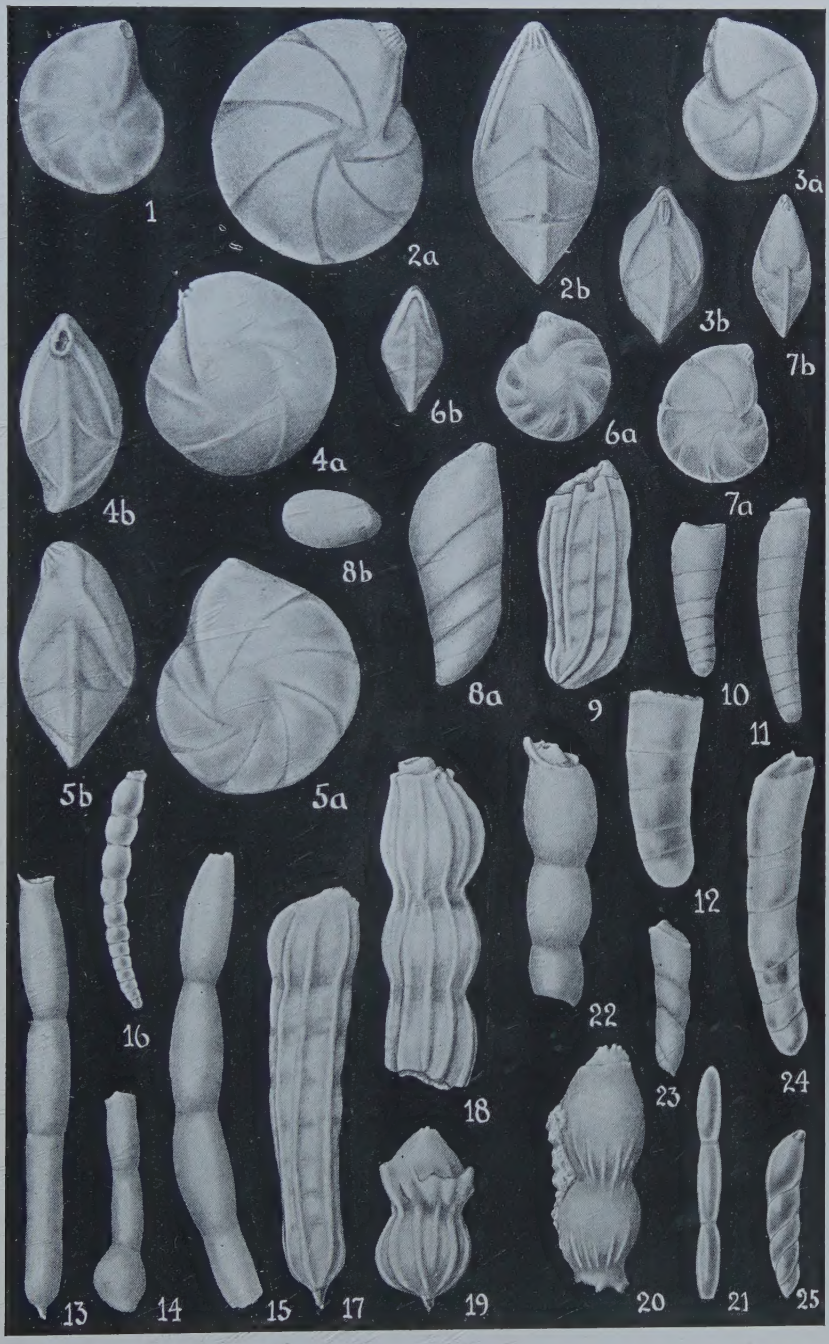
FIGS. 17–19. *Dentalina substrigata* (Stache). Figs. 17, 18, × 22; 19, × 33.

FIG. 20. *Dentalina capitata* (Boll) (?). × 30.

FIG. 21. *Nodosaria ewaldi* Reuss. × 35.

FIGS. 22–25. *Dentalina obliquisuturata* Stache. Figs. 22, 23, × 35; 24, × 50; 25, × 30.

Figures drawn by Margaret S. Moore.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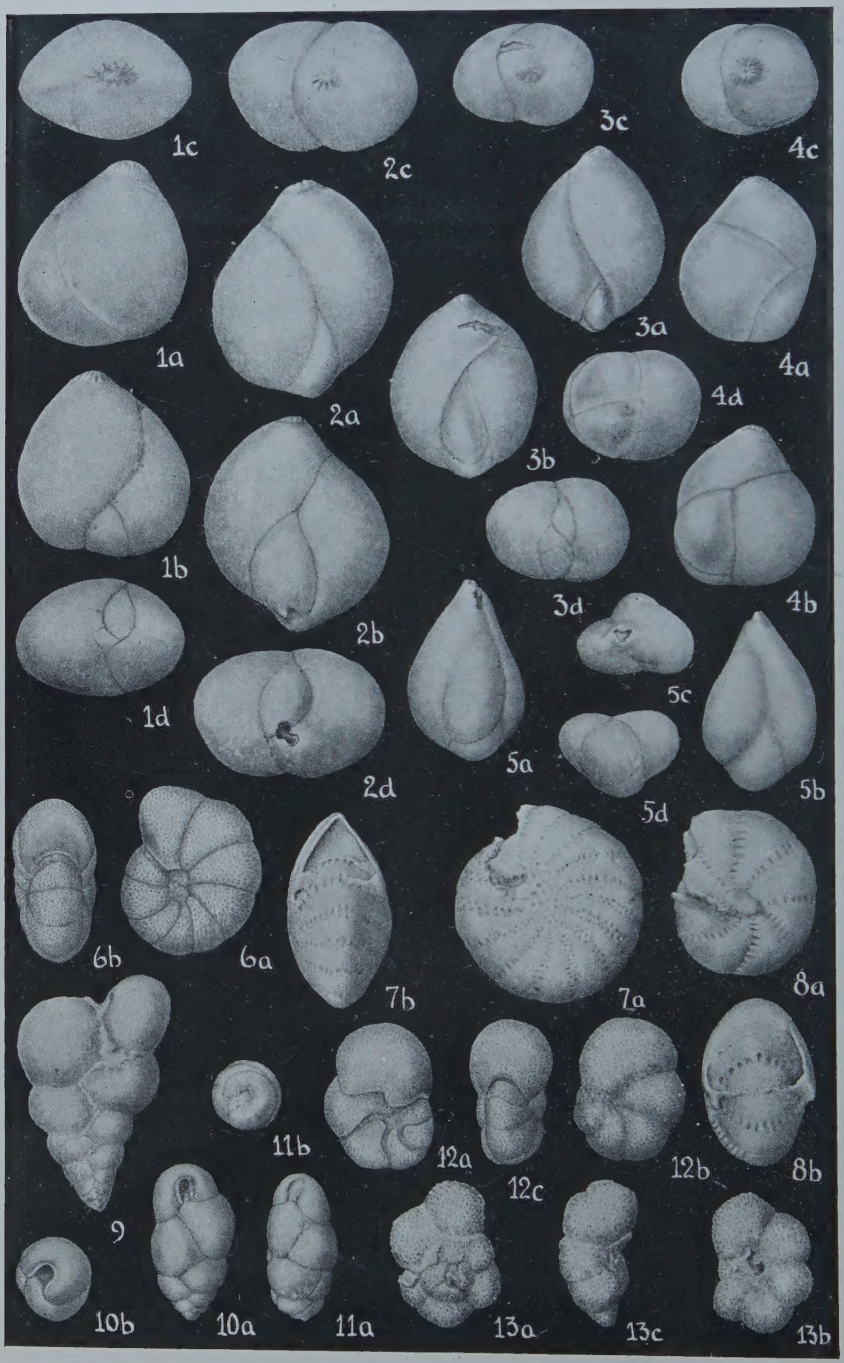
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GLOBULINA LANDESI (Hanna and Hanna) (Pl. 8, figs. 1-3)

Polymorphina landesi HANNA and HANNA, Univ. Wash. Publ. Geol., vol. 1, No. 4, 1924, p. 60, pl. 13, figs. 16, 17.

Globulina landesi CUSHMAN and OZAWA, Proc. U. S. Nat. Mus., vol. 77, Art. 6, 1930, p. 71, pl. 15, figs. 9 *a*, *b*.

Our figures, although similar in essential details, give some of the different appearances of this rather variable species, several specimens of which were found in the Poway. This species was originally described from the Eocene, Cowlitz formation, of Lewis County, Washington.

GLOBULINA GIBBA d'Orbigny, var. (Pl. 8, figs. 4 a-d)

This form is very rare in the Poway material, and the single specimen figured is the best representative. It may be the young stage of some other form of which we do not have the adult, and is, therefore, included only with some considerable question in d'Orbigny's species.

EXPLANATION OF PLATE 8

FIGS. 1–3. *Globulina landesi* (Hanna and Hanna). × 50. *a*, *a*, *a*, *b*, *b*, *b*, side views; *c*, *c*, *c*, apertural views; *d*, *d*, *d*, basal views.

FIGS. 4 *a–d*. *Globulina gibba* d'Orbigny, var. × 50. *a*, *b*, side views; *c*, apertural view; *d*, basal view.

FIGS. 5 *a–d*. *Guttulina hantkeni* Cushman and Ozawa. × 50. *a*, *b*, side views; *c*, apertural view; *d*, basal view.

FIGS. 6 *a*, *b*. *Nonion planatum* Cushman and Thomas. × 60. *a*, side view; *b*, apertural view.

FIGS. 7 *a*, *b*. *Elphidium smithi* Cushman and Dusenbury, n. sp. × 30. *a*, side view; *b*, apertural view.

FIGS. 8 *a*, *b*. *Elphidium schencki* Cushman and Dusenbury, n. sp. × 40. *a*, side view; *b*, apertural view.

FIG. 9. *Gümbelina striata* (Ehrenberg). × 80.

FIGS. 10 *a*, *b*. *Bulimina capitata* Yokoyama (?). × 50. *a*, front view; *b*, apertural view.

FIGS. 11 *a*, *b*. *Bulimina schwageri* Yokoyama (?). × 50. *a*, front view; *b*, apertural view.

FIGS. 12 *a–c*. *Valvulineria involuta* Cushman and Dusenbury, n. sp. × 50. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIGS. 13 *a–c*. *Globigerina cretacea* d'Orbigny (?). × 50. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

Figures drawn by Margaret S. Moore.

GUTTULINA HANTKENI Cushman and Ozawa (Pl. 8, figs. 5 a-d)

Polymorphina acuta HANTKEN (not D'ORBIGNY), A magy. kir. földt. int. évkön., vol. 4, 1875 (1876), p. 51, pl. 8, fig. 4 (*acuminata* on explanation of plate); Mitth. Jahrb. ungar. geol. Anstalt, vol. 4, 1875 (1881), p. 60, pl. 8, fig. 4.

Guttulina hantkeni CUSHMAN and OZAWA, Proc. U. S. Nat. Mus., vol. 77, Art. 6, 1930, p. 33, pl. 5, figs. 4-6.

The single young specimen figured from the Poway seems to be very similar to those recorded from the Claiborne Eocene of New Jersey and Louisiana.

GLANDULINA LAEVIGATA d'Orbigny, var. OVATA Cushman and Applin

Nodosaria (*Glandulina*) *laevigata* D'ORBIGNY, var. *ovata* CUSHMAN and APPLIN, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 169, pl. 7, figs. 12, 13.

There are several specimens in our material which seem to be identical with those described from the Upper Eocene of Texas, and also recorded elsewhere in the American Upper Eocene.

NONION PLANATUM Cushman and Thomas (Pl. 8, figs. 6 a, b)

Nonion planatum CUSHMAN and THOMAS, Journ. Pal., vol. 4, 1930, p. 37, pl. 3, figs. 5 *a*, *b*.

There are numerous specimens in our collection from the Poway which seem identical with this species described from the Cooks Mountain formation of Sabine County, Texas. The form is rather widely distributed in the Upper and Middle Eocene of America.

ELPHIDIUM SCHENCKI Cushman and Dusenbury, n. sp. (Pl. 8, figs. 8 a, b)

Test small, close coiled, thick, the thickness being about two-thirds the diameter, periphery broadly rounded; chambers comparatively few, six or seven in the adult whorl, very slightly inflated; sutures in the adult very slightly depressed, slightly curved, retral processes single, numerous; wall finely perforate. Diameter 0.55 mm.; thickness 0.40 mm.

Holotype from the Eocene, Poway conglomerate of Murray Canyon, La Jolla Quadrangle, San Diego County, California.

The genus *Elphidium* is rare in the Eocene. This species very superficially resembles *E. eocenicum* Cushman and Ellisor (Contr. Cushman Lab. Foram. Res., vol. 7, 1931, p. 53, pl. 7, figs.

6 *a, b*), but is completely involute, much thicker, and with sutures very slightly if at all depressed, while in that species they are very distinctly depressed and the chambers are somewhat inflated.

ELPHIDIUM SMITHI Cushman and Dusenbury, n. sp. (Pl. 8, figs. 7 a, b)

Test of medium size, completely involute, slightly umbonate, the diameter about twice as great as the thickness, periphery narrowly rounded to subacute; chambers numerous, 16-18 in the last-formed coil; sutures distinctly curved and depressed, retral processes very numerous, usually appearing as a double line of minute, irregularly spaced pores; wall smooth, polished and very finely perforate. Diameter 1.00 mm.; thickness 0.50 mm.

Holotype from the Eocene, Poway conglomerate of Murray Canyon, La Jolla Quadrangle, San Diego County, California.

This is a somewhat larger species than the preceding, and has many more chambers to a coil. The more strongly curved sutures and the retral processes with their series of double pores make it distinct from any of the known Early Tertiary forms. It occurs more abundantly and in greater size in a sample collected by C. C. Church from the type Tejon of Live Oak Creek, Kern County, California.

GÜMBELINA STRIATA (Ehrenberg) (Pl. 8, fig. 9)

Textularia striata EHRENBERG, Abh. kön. Akad. Wiss. Berlin, 1838, p. 135, pl. 4, fig. *a*.

In our collection there are a number of specimens of *Gümbelina* very close to *G. striata* (Ehrenberg). Most appear to be somewhat crushed and attached to each other by matrix, and there is therefore the probability that these have been reworked from some Cretaceous source.

BULIMINA CAPITATA Yokoyama (?) (Pl. 8, figs. 10 a, b)

Bulimina capitata YOKOYAMA, Palaeontographica, vol. 36, 1890, p. 190, pl. 24, figs. 10 *a-c*.

The figured specimen from the Poway conglomerate is very similar in many respects to that described from Japan by Yokoyama under the above name. This and the following species he recorded as from the Miocene.

BULIMINA SCHWAGERI Yokoyama (?) (Pl. 8, figs. 11 a, b)

Bulimina schwageri YOKOYAMA, l. c., 1890, p. 190, pl. 24, figs. 6-8.

This form from the Poway has been referred to Yokoyama's species. This and the preceding species are similar in many respects, but there seems to be a decided difference in their later stages, those of one expanding continuously, those of the other contracting definitely toward the apertural end with a considerable lessening in the size of the chambers.

GYROIDINA SOLDANII (d'Orbigny), var. OCTOCAMERATA Cushman and G. D. Hanna

Gyroidina soldanii (D'ORBIGNY), var. *octocamerata* CUSHMAN and G. D. HANNA, Proc. Calif. Acad. Sci., ser. 4, vol. 16, 1927, p. 223, pl. 14, figs. 16-18.

This variety was originally described from the Eocene, 7 miles north of Coalinga, California, and has since been recorded from numerous localities in the Upper Eocene of the Gulf Coastal Plain of the United States and Mexico, as well as from the Eocene of the west coast.

EPONIDES GUAYABALENSIS Cole, var. YEGUAENSIS Weinzierl and Applin (Pl. 9, figs. 1 a-c)

Eponides guayabalensis COLE, var. *yeguaensis* WEINZIERL and APPLIN, Journ. Pal., vol. 3, 1929, p. 406, pl. 42, figs. 2 *a-c*.

Our specimens are very close indeed to this form described from the Yegua of Texas. The periphery is sharp and the number of chambers similar to that in the types with which our material has been compared. There is much less thickening in the umbilical region of the ventral side than in the typical form of the species, the variety often having almost no such thickening.

SIPHONINA CLAIBORNENSIS Cushman

Siphonina claibornensis CUSHMAN, Proc. U. S. Nat. Mus., vol. 72, Art. 20, 1927, p. 4, pl. 3, figs. 5 *a-c*.—COLE, Bull. Amer. Pal., vol. 14, No. 53, 1928, p. 221(21).—CUSHMAN and THOMAS, Journ. Pal., vol. 3, 1929, p. 181, pl. 24, figs. 2 *a-c*.

There are numerous specimens in the Poway material which seem to be identical with this species which was described from the Claiborne of Mississippi. There are usually five chambers in the last-formed volution. The dorsal side is nearly flat, but the ventral side is slightly inflated. The sutures are distinct and

strongly oblique on the dorsal side and somewhat limbate on the ventral side, where they are nearly radial and somewhat depressed. The aperture is elongate, elliptical, occupying nearly the whole height of the chamber, and usually showing very little in the way of a distinct lip.

VALVULINERIA INVOLUTA Cushman and Dusenbury, n. sp. (Pl. 8, figs. 12 a-c)

Test small, almost completely involute, periphery broadly rounded, dorsal side more convex than the ventral; chambers few, 5 or 6 composing the last-formed whorl, expanding rather rapidly in size as added, the last chamber constituting about one-third of the area of the test, distinctly inflated; sutures distinct, depressed, very slightly curved on the dorsal side, ventrally somewhat sigmoid and limbate; wall smooth but distinctly perforate; aperture, a low opening near the periphery with an extension onto the ventral side, covered by a lip-like prolongation of the ventral side of the final chamber. Length 0.40 mm.; breadth 0.30 mm.; thickness 0.25 mm.

Holotype from the Eocene, Poway conglomerate of Murray Canyon, La Jolla Quadrangle, San Diego County, California.

This seems to be a small but distinctive species not recorded previously as far as we are able to determine.

GLOBIGERINA CRETACEA d'Orbigny (?) (Pl. 8, figs. 13 a-c)

There are a few specimens, one of which is here figured, which in their general characteristics resemble forms usually assigned to *Globigerina cretacea* d'Orbigny. Owing to the fact that *Gümbelina striata* (Ehrenberg) also occurs in this material, it would seem possible that these two forms have been derived from Cretaceous sediments during the deposition of the Poway conglomerate. Most of the specimens are much compressed and distorted.

ANOMALINA COALINGENSIS Cushman and G. D. Hanna (Pl. 9, figs. 3 a-c)

Anomalina coalingensis CUSHMAN and G. D. HANNA, Proc. Calif. Acad. Sci., ser. 4, vol. 16, 1927, p. 221, pl. 14, figs. 10-12.

Our specimens, while they show some variation, have the essential characters of this species described from the Eocene of Coalinga. The umbonal region has a prominent boss with large perforations, and the entire wall is only a little less coarsely perforate. One side of the test is more convex than the other.

As a general rule, the poorer the preservation of the specimen, the larger the perforations become; and it may well be that this coarse perforation cannot be wholly regarded as a specific character. Some of our specimens grade toward the closely related species *A. umbonata* Cushman, described from the Eocene of Mexico, but they are nearer to the California species.

ANOMALINA AFFINIS (Hantken) (?) (Pl. 9, figs. 2 a-c)

There are numerous small specimens in the Poway, some of which rather closely resemble Hantken's species, especially forms that occur in the Eocene of the Gulf Coastal Plain of the United States. There is considerable variation in these, however, and some of them may represent the early stages of other forms.

CIBICIDES MARTINEZENSIS Cushman and Barksdale

Cibicides martinezensis CUSHMAN and BARKSDALE, Contr. Dept. Geol. Stanford Univ., vol. 1, No. 2, 1930, p. 68, pl. 12, figs. 9 *a-c.*

There are numerous specimens from the Poway which very closely resemble this species described from the Lower Eocene, Martinez formation, one mile east of Martinez, Contra Costa County, California. The slightly smaller Poway specimens are somewhat sharper in their preservation, and the characters of the test are therefore more clearly shown. Otherwise the two sets of material seem to be very much alike.

CIBICIDES PSEUDOWUELLERSTORFI Cole (Pl. 9, figs. 4 a-c)

Cibicides pseudowuellerstorfi COLE, Bull. Amer. Pal., vol. 14, No. 51, 1927, p. 36, pl. 1, figs. 13, 14.

Our figured specimen shows a strongly biconvex example of this rather highly ornate species described by Cole from the Eocene, Guayabal formation, of Mexico. As usual with species of this genus, there is considerable variation in the convexity of the dorsal side.

CIBICIDES SASSEI Cole (Pl. 9, figs. 5 a-c)

Cibicides sassei COLE, Bull. Amer. Pal., vol. 14, 1927, p. 35, pl. 4, figs. 10, 11.—CUSHMAN and THOMAS, Journ. Pal., vol. 3, 1929, p. 182, pl. 24, figs. 4 *a-c;* l. c., vol. 4, 1930, p. 41, pl. 4, figs. 4 *a-c.*

The figured specimen from the Poway conglomerate is one of

a series that shows considerable variation, particularly in the relative amount of convexity of the dorsal side. It is much less ornamented than the preceding. The species has been recorded from the Claiborne or its equivalents of Mexico and Texas.

146. NEW SPECIES OF TRILOCULINA FROM THE CLAIBORNE OF LOUISIANA

By J. A. CUSHMAN and J. B. GARRETT, JR.

The following three species of *Triloculina* are apparently undescribed. They are all highly ornamented forms and should make good markers for this particular horizon as it occurs in this general region.

TRILOCULINA MIRIFICA Cushman and Garrett, n. sp. (Pl. 9, figs. 11-14)

Test somewhat longer than broad, much compressed, periphery broadly rounded, apertural end somewhat projecting; chambers fairly distinct, inflated, the last three making up the entire surface of the test; sutures indistinct, obscured by the ornamentation; wall thick, calcareous, ornamented by numerous, nearly transverse costae which are rounded and separated by deep depressions; aperture rounded, often with a slight tooth, at the end of a short cylindrical neck, with a slightly thickened rim. Length 0.45-0.50 mm.; breadth 0.25-0.30 mm.; thickness 0.15-0.18 mm.

Holotype (Cushman Coll. No. 21271) from the Claiborne Eocene, Cook Mountain formation, Sabine Parish, Louisiana.

This species is a very highly ornamented one as will be seen by the series of figures which show the extremes of variation in the considerable series which we have had for study. Very remotely this species in its ornamentation suggests *Quinqueloculina parkeri* (H. B. Brady).

TRILOCULINA INUSITATA Cushman and Garrett, n. sp. (Pl. 9, figs. 8-10)

Test comparatively small, somewhat compressed, somewhat longer than broad, the basal end broadly rounded, apertural end somewhat contracted; chambers fairly distinct, somewhat inflated, the last three making up the entire surface; sutures obscured by the ornamentation; wall calcareous, ornamented by several, high, longitudinal costae, generally parallel to the periphery of the chamber and crossed at irregular intervals by secondary costae nearly at right angles to the primary ones; aperture small, rounded, at the end of a short cylindrical neck, with a thickened lip. Length 0.35-0.40 mm.; breadth 0.20 mm.; thickness 0.15 mm.

Holotype (Cushman Coll. No. 21273) from the Claiborne Eocene, Cook Mountain formation, Sabine Parish, Louisiana.

This is a very highly ornamented species and subject to a considerable amount of variation as shown in our figures. The

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EXPLANATION OF PLATE 9

FIGS. 1 *a–c.* *Eponides guayabalensis* Cole, var. *yeguaensis* Weinzierl and Applin. × 30. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIGS. 2 *a–c.* *Anomalina affinis* (Hantken) (?). × 50. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIGS. 3 *a–c.* *Anomalina coalingensis* Cushman and G. D. Hanna. × 35. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIGS. 4 *a–c.* *Cibicides pseudowuellerstorfi* Cole. × 50. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

FIGS. 5 *a–c.* *Cibicides sassei* Cole. × 50. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

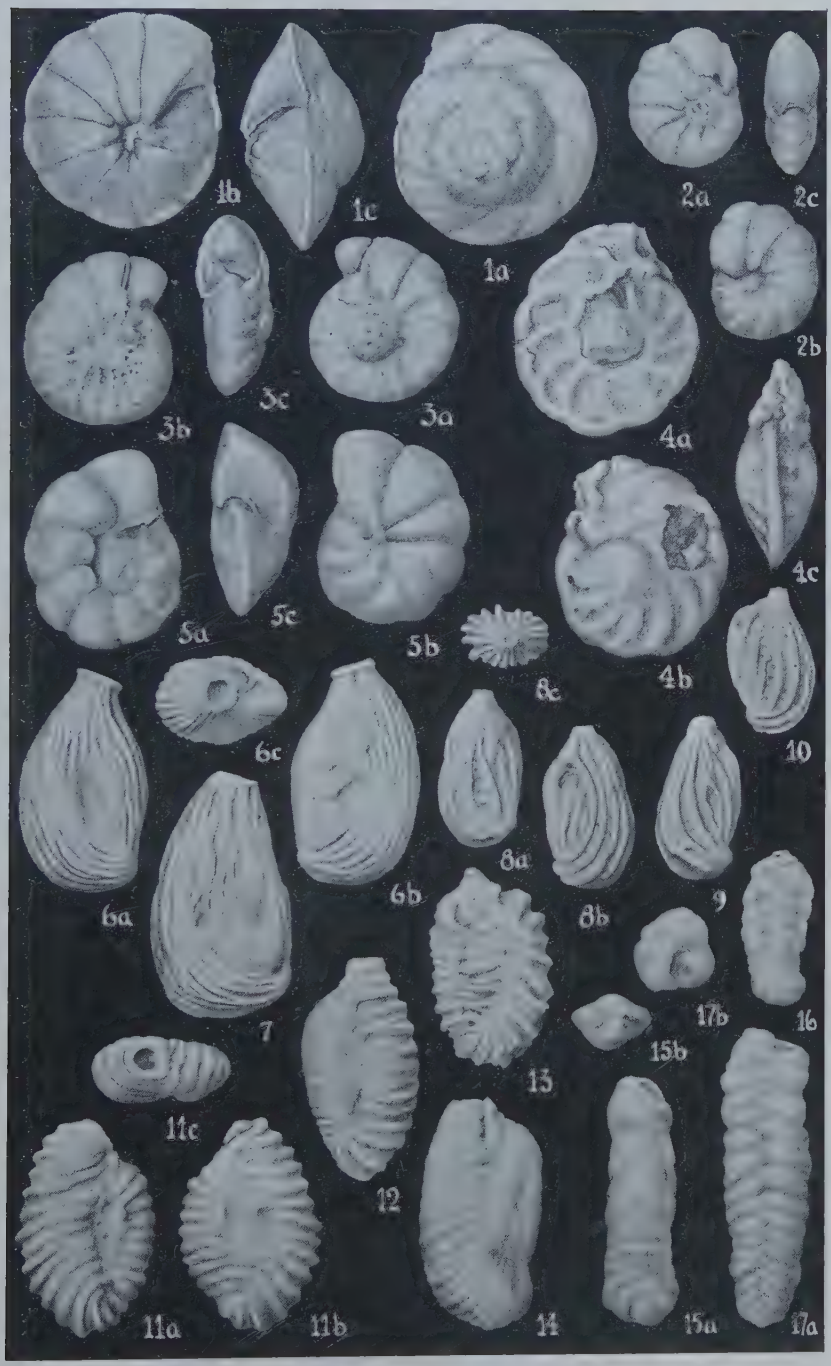
FIGS. 6, 7. *Triloculina paulocostata* Cushman and Garrett, n. sp. × 60. Fig. 6, Holotype. *a*, *b*, opposite sides; *c*, apertural view. Fig. 7, Paratype.

FIGS. 8–10. *Triloculina inusitata* Cushman and Garrett, n. sp. × 60. Fig. 8, Holotype. *a*, *b*, opposite sides; *c*, apertural view. Figs. 9, 10, Paratypes.

FIGS. 11–14. *Triloculina mirifica* Cushman and Garrett, n. sp. × 60. Fig. 11, Holotype. *a*, *b*, opposite sides; *c*, apertural view. Figs. 12-14, Paratypes showing variation in the surface ornamentation.

FIGS. 15–17. *Spiroplectoides californica* Cushman and Campbell, n. sp. × 35. Fig. 15, Holotype. *a*, front view; *b*, apertural view. Figs. 16, 17, Paratypes. 17 *a*, front view; *b*, apertural view.

Figures drawn by Margaret S. Moore.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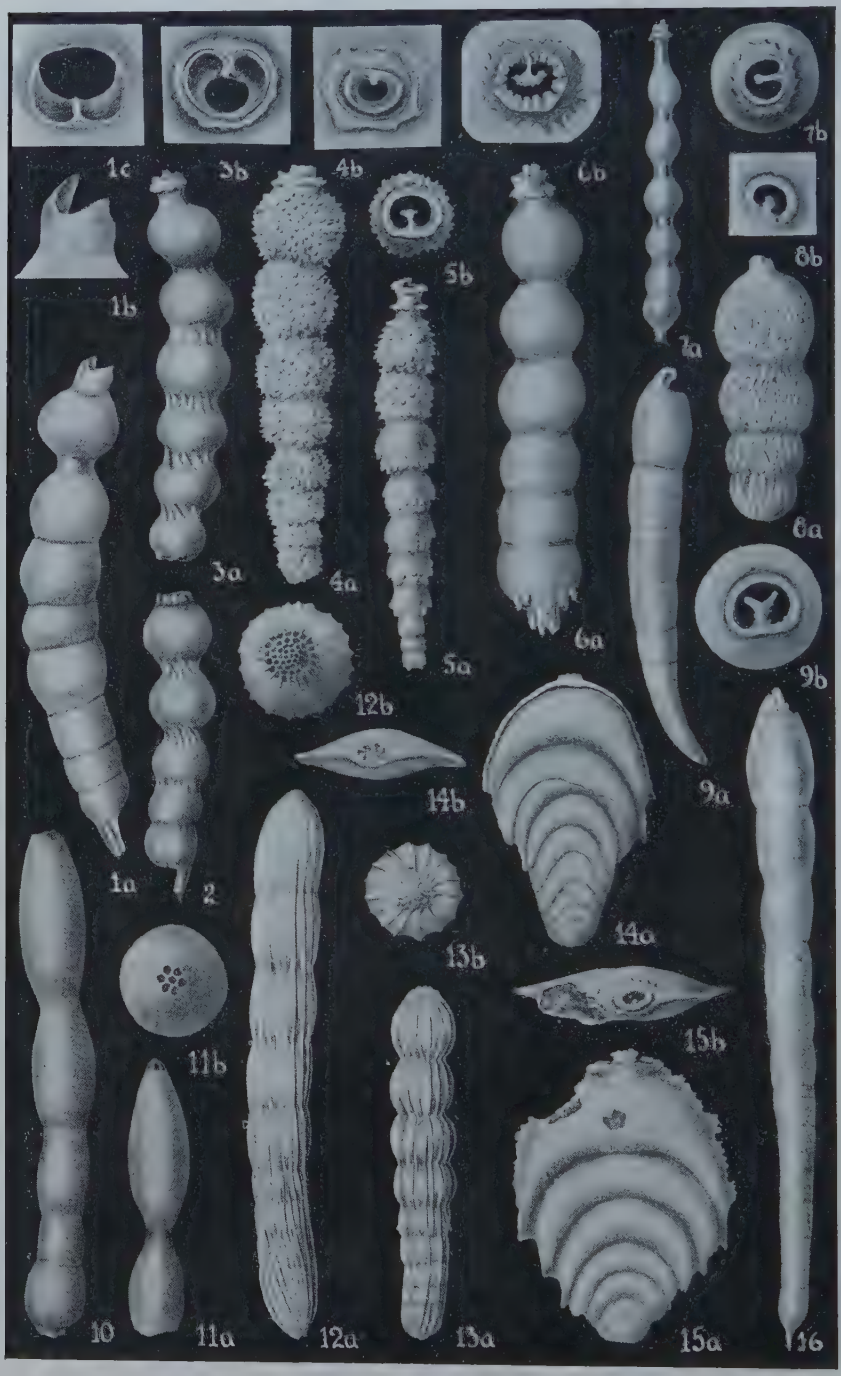
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primary costae are always very sharply marked, but the secondary costae at right angles to them are frequently confined to the basal end of the chamber, or may be almost wanting in some specimens.

TRILOCULINA PAULOCOSTATA Cushman and Garrett, n. sp. (Pl. 9, figs. 6, 7)

Test of medium size, about 1½ times as long as broad, very slightly compressed, periphery broadly rounded, basal end very broadly rounded, almost truncate, apertural end much contracted; chambers and sutures largely obscured by the ornamentation which consists of numerous, small, rounded costae with narrow

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EXPLANATION OF PLATE 10

FIGS. 1 *a–c.* *Ellipsonodosaria verneuili* (d'Orbigny). *a*, side view, × 20; *b*, side view of apertural end, × 80; *c*, aperture, × 80.

FIGS. 2, 3. *Ellipsonodosaria verneuili* (d'Orbigny), var. *paucistriata* (Galloway and Morrey). Fig. 2, Basal portion, × 20. Fig. 3, *a*, apertural portion of another specimen, × 22; *b*, aperture, × 80.

FIGS. 4 *a, b.* *Ellipsonodosaria* sp(?). *a*, side view, × 20; *b*, aperture, × 50.

FIGS. 5 *a, b.* *Ellipsonodosaria* sp(?). *a*, side view, × 20; *b*, aperture, × 35.

FIGS. 6 *a, b.* *Ellipsonodosaria nuttalli* Cushman and Jarvis, n. sp. *a*, side view, × 30; *b*, aperture, × 60.

FIGS. 7 *a, b.* *Ellipsonodosaria nuttalli* Cushman and Jarvis, n. sp., var. *gracillima* Cushman and Jarvis, n. var. *a*, side view, × 20; *b*, aperture, × 80.

FIGS. 8 *a, b.* *Ellipsonodosaria mappa* Cushman and Jarvis, n. sp. *a*, side view, × 30; *b*, aperture, × 70.

FIGS. 9 *a, b.* *Ellipsonodosaria dentaliniformis* Cushman and Jarvis, n. sp. *a*, side view, × 35; *b*, aperture, × 80.

FIGS. 10, 11. *Chrysalogonium elongatum* Cushman and Jarvis, n. sp. Fig. 10, Holotype. Side view, showing early stages, × 20. Fig. 11, Paratype showing apertural end. *a*, side view, × 20; *b*, aperture, × 40.

FIGS. 12 *a, b.* *Chrysalogonium longicostatum* Cushman and Jarvis, n. sp. *a*, side view, × 20; *b*, apertural view, × 35.

FIGS. 13 *a, b.* *Chrysalogonium breviloculum* Cushman and Jarvis, n. sp. *a*, side view, × 20; *b*, aperture, × 35.

FIGS. 14, 15. *Plectofrondicularia spinifera* Cushman and Jarvis. × 35. *a, a*, side views; *b, b*, apertural views.

FIG. 16. *Chrysalogonium lanceolum* Cushman and Jarvis, n. sp. × 20.

Figures drawn by Margaret S. Moore.

depressions between, generally parallel to the periphery of the chamber; aperture rounded, at the end of a very slightly tapering neck, expanded slightly into a rounded lip. Length 0.50-0.55 mm.; breadth 0.25-0.30 mm.; thickness 0.20 mm.

Holotype (Cushman Coll. No. 21275) from the Claiborne Eocene, Cook Mountain formation, Sabine Parish, Louisiana.

This species is also a very highly ornamented and very definitely formed one, and is very characteristic showing comparatively little variation in the large series that we have.

147. A NEW SPIROPLECTOIDES FROM THE CRETACEOUS OF CALIFORNIA

By Joseph A. Cushman and Arthur S. Campbell

In the previous part of these Contributions notes were given on the various species of *Spiroplectoides*. The present species from California belongs to that group which has siliceous walls and is allied to the forms known from Trinidad and Mexico, but is not identical. It should prove to be a rather distinct marker for this part of the California Cretaceous.

SPIROPLECTOIDES CALIFORNICA Cushman and Campbell, n. sp. (Pl. 9, figs. 15-17)

Test elongate, several times as long as broad, sides nearly parallel for most of their length, or slightly increasing in diameter toward the apertural end, angles slightly rounded or more usually acute with a slight keel, transverse section rhombic; chambers fairly distinct, the early ones planispirally coiled, later ones regularly biserial, in the adult averaging about three times as broad as high, thickest near the inner margin; sutures distinct, somewhat limbate, slightly depressed, nearly straight, forming an angle of 25°-35° with the horizontal; wall apparently siliceous, distinctly but finely perforate; aperture elongate, semi-elliptical, at the end of the last-formed chamber. Microspheric

specimens up to 1.37 mm. in length; breadth 0.35 mm. Megalospheric form up to 0.80 mm. in length; breadth 0.30 mm.

Holotype (Cushman Coll. No. 21294) from the Upper Cretaceous, Upper Chico, near Selby, California.

The species also occurs in the Chico beds in the Devil's Den, near Bakersfield, California, and in the Moreno shale at Panoche Canyon, near Coalinga, California. The species is nearly always associated with *Silicosigmoilina californica* Cushman and G. D. Hanna, a common species of the Chico of California.

The species varies in the thickness of the last-formed portion which often becomes as thick as broad, as in the figured microspheric specimen. It is probably most closely related to *S. clotho* (Grzybowski), but the chambers are not as low and broad as in that species, and the shape of the microspheric form is not so definitely lance-shaped. It is a larger species than *S. papillata* Cushman, and does not have the distinct papillate surface. From *S. flexuosa* (Reuss) and *S. rosula* (Ehrenberg) the California species differs in the much broader form of both test and chambers.

148. SOME INTERESTING NEW UNISERIAL FORAMINIFERA FROM TRINIDAD

By J. A. Cushman and P. W. Jarvis

The continued collecting by the junior author has resulted in the finding of many interesting and beautifully preserved foraminifera. The delicate apertural characters which are often missing in these forms have shown that while they would usually be placed in either *Nodosaria* or *Dentalina*, they really belong elsewhere. The forms described here are only a few of the very interesting group which has been found in the Lower Miocene of Trinidad. Descriptions of these forms follow.

ELLIPSONODOSARIA NUTTALLI Cushman and Jarvis, n. sp. (Pl. 10, figs. 6 a, b)

Nodosaria abyssorum GUPPY (not BRADY), Proc. Victoria Instit. Trinidad, vol. 2, 1904, p. 12, pl. 1, figs. 10, 11; Geol. Mag., Dec. 5, vol. 1, 1904, p. 246, pl. 8, figs. 8, 9.—NUTTALL, Quart. Journ. Geol. Soc., vol. 84, 1928, p. 81, pl. 5, fig. 2.

Test elongate, all except the early portion at least, uniserial, circular in transverse section, initial end with numerous short spines; chambers distinct, inflated, those of the early portion closely set, later becoming more distinct; sutures distinct, depressed, especially in the later portion, slightly limbate; wall smooth, except at the base and about the aperture; aperture complex, pentagonal, with a toothed frill below the aperture on the neck, the aperture itself with a distinct, expanded lip, the opening with a tooth-like process extending above the aperture, and in end view narrow at the base with a slightly expanded portion in the aperture itself. Length 3.00 mm.; diameter 0.50 mm.

Holotype (Cushman Coll. No. 21435) from the Upper Middle Miocene, "*Sagrina* beds," Trinidad Point, Oropouche Lagoon, Trinidad, B. W. I.

This species has been figured by both Guppy and Nuttall from the Miocene of Trinidad. The apertural characters of our material seem to be very different from that figured and described by Brady.

ELLIPSONODOSARIA NUTTALLI Cushman and Jarvis, n. sp., var. GRACILLIMA Cushman and Jarvis, n. var. (Pl. 10, figs. 7 a, b)

Nodosaria soluta MARTINOTTI (not REUSS), Atti Soc. Ital. Sci. Nat., vol. 62, 1923, p. 331, pl. 7, figs. 19, 20.

Nodosaria knihnitziana NUTTALL (not KARRER), Quart. Journ. Geol. Soc., vol. 84, 1928, p. 81, pl. 4, figs. 9, 10.

Variety differing from the typical in a much slenderer form, and a tendency for the chambers to become more remote, the neck very elongate, and the initial end with a single spine. Length 2.00 mm.; diameter 0.25 mm.

Holotype of variety (Cushman Coll. No. 21436) from Lower Miocene, Cipero section (Jarvis Station 13), San Fernando, Trinidad, B. W. I.

The above references all apparently are to the same form. It would seem to be distinct from *E. nuttalli*, but there are numerous specimens which seem to connect the two. The apertural characters are much simpler in the varietal form, although the toothed frill is present, but the upper portion is less complex.

ELLIPSONODOSARIA MAPPA Cushman and Jarvis, n. sp. (Pl. 10, figs. 8 a, b)

Test short, stout, 2½-3 times as long as broad, composed of 3 or 4 chambers in the adult, increasing in size as added; chambers distinct, somewhat inflated, last-formed ones more distinct; sutures distinct, depressed; wall ornamented by numerous, irregular, longitudinal costae in the early portion, in the middle portion becoming shorter and somewhat anastomosing, and in the final chamber often spinose; aperture with a short neck, distinct lip and inwardly projecting tooth which is bluntly rounded. Length 1.35 mm.; diameter 0.50 mm.

Holotype (Cushman Coll. No. 21437) from the Lower Middle Miocene, green clay, Cipero section (Jarvis Station 14), San Fernando, Trinidad, B. W. I.

This is a peculiar species in its very distinct ornamentation which changes markedly as the chambers are developed.

ELLIPSONODOSARIA DENTALINIFORMIS Cushman and Jarvis, n. sp. (Pl. 10, figs. 9 a, b)

Test somewhat curved, tapering from the subacute end to the greatest breadth at the last-formed chamber; chambers distinct, only slightly inflated, at the apertural end increasing in length as added; sutures distinct, somewhat limbate, depressed slightly in the later portion; wall smooth; aperture rounded, but flattened at one side with a distinct hood-like projection of the wall, in end view appearing as a bifid tooth, the edges slightly serrate. Length 1.30 mm.; diameter 0.20 mm.

Holotype (Cushman Coll. No. 21438) from the Lower Middle Miocene, green clay, Cipero section (Jarvis Station 13), San Fernando, Trinidad, B. W. I.

The apertural characters of this species are very interesting, showing apparently very close relationships to some of the biserial forms of the Ellipsoidinidae. From its general shape, it might be included under the generic name, *Ellipsodentalina*, proposed by Liebus.

CHRYSALOGONIUM ELONGATUM Cushman and Jarvis, n. sp. (Pl. 10, figs. 10, 11)

Test elongate, slender, arcuate; chambers distinct, increasing in length as added; sutures distinct, becoming strongly depressed in the later portion; wall smooth; aperture consisting of a central small polygonal opening surrounded by a ring of similar openings occupying the terminal end of the chamber. Length 3.50 mm.; diameter 0.40 mm.

Holotype (Cushman Coll. No. 21439) from the Lower Miocene, Cipero section (Jarvis Station 13), San Fernando, Trinidad, B. W. I.

This species should evidently be placed in the genus *Chrysalogonium*. In some specimens there is a tendency for another ring of pores to be developed. Numerous specimens have been studied chamber by chamber, but have failed to show any interior tube or plate so far as we have seen.

CHRYSALOGONIUM LONGICOSTATUM Cushman and Jarvis, n. sp. (Pl. 10, figs. 12 a, b)

Test elongate, slightly arcuate, tapering at either end, but the sides otherwise nearly parallel throughout; chambers numerous, fairly distinct, very slightly inflated, increasing in length as added; sutures fairly distinct, very slightly depressed; wall ornamented by numerous costae, numbering usually 14-18, continuous over nearly the entire length of the test; aperture consisting of a definite sieve plate composed of a concentric ring of rounded or slightly polygonal openings, the outer ring somewhat separated by raised ridges. Length 5.00-6.00 mm.; diameter 0.45 mm.

Holotype (Cushman Coll. No. 21441) from the Lower Miocene, Cipero section (Jarvis Station 13), San Fernando, Trinidad, B. W. I.

This species, when well preserved, shows a very complex aperture. The outer portion starts as though it were radiating, and then the ridges coalesce and form a series of concentric openings, distinctly forming the conical end of the test.

CHRYSALOGONIUM BREVILOCULUM Cushman and Jarvis, n. sp. (Pl. 10, figs. 13 a, b)

Test elongate, slightly increasing in diameter toward the apertural end; chambers distinct, becoming much inflated toward the apertural end, increasing slightly in size as added; sutures distinct, somewhat limbate in the early portion, becoming depressed toward the apertural end; wall ornamented by numerous longitudinal costae, about eight in the early portion with intermediary ones added in the later chambers; aperture, a sieve-like plate nearly flat, composed of numerous polygonal openings. Length 2.00-2.50 mm.; diameter 0.40 mm.

Holotype (Cushman Coll. No. 21442) from the Lower Miocene, Cipero section (Jarvis Station 13), San Fernando, Trinidad, B. W. I.

This species may be distinguished from the preceding by the increase in inflation of the later chambers, the more distinct costae, and the nearly flat apertural end, compared with the distinctly conical one of *C. longicostatum.*

CHRYSALOGONIUM LANCEOLUM Cushman and Jarvis, n. sp. (Pl. 10, fig. 16)

Test very elongate, gradually tapering, with the greatest diameter toward the apertural end, slender, usually slightly arcuate, initial end with a single acicular spine; chambers numerous, distinct, very gradually increasing in length as added, slightly inflated toward the apertural end; sutures distinct, limbate, slightly depressed; wall smooth; aperture at the periphery, appearing radiate, the ridges between the openings coalescing, and forming an alternate series of rounded or slightly elongate pores, making up the tip of the test. Length 4.50 mm.; diameter 0.40 mm.

Holotype (Cushman Coll. No. 21445) from the Lower Miocene, Cipero section (Jarvis Station 13), San Fernando, Trinidad, B. W. I.

The apertural characters of this species are very interesting, the basal portion appearing as though it were a typical nodosarian form with radiate slits separated by ridges, but these ridges later unite and then again separate to form a series of rounded openings which alternate with the previous elongate slits, and this may be continued in a series of such alternating rounded openings. So far as seen, the interior has no connecting rod or plate between the apertures of successive chambers.

On Plate 10 will be found some additional figures to those of the new species described here. In particular, attention is called to the peculiar apertural characters in figures 14 and 15 of the species previously described by us as *Plectofrondicularia spinifera.* The similarity of the aperture in figure 15 *b* to that of such forms as the Ellipsonodosarias in figures 4 and 5 is striking, and the toothed character in figure 14 *b* is also interesting.

This whole series shows that much further study is needed in the relationships of the apertural characters of the Ellipsoidinidae, Buliminidae, and perhaps other groups. The material, so well preserved in Trinidad, gives an exceptional opportunity for such studies, and should show important relationships in these different groups.

RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the foraminifera that have come to hand.

Natland, Manley L. The Temperature and Depth-Distribution of Some Recent and Fossil Foraminifera in the Southern California Region.—Bull. Scripps Inst. Oceanography, Tech. Ser., vol. 3, No. 10, 1933, pp. 225-230, table. **R.**

Wickenden, R. T. D. Jurassic Foraminifera from Wells in Alberta and Saskatchewan.—Trans. Roy. Soc. Canada, 3rd ser., Sect. IV, vol. XXVII, 1933, pp. 157-170, pls. 1, 2. **J.**—28 species figured and described, none new.

Persch, F. Mikropaläontologische Untersuchung von Bohrkernen in Kalifornien und die Anwendbarkeit dieses Verfahrens in Deutschland.—"Ol und Kohle," Heft 1, 1933, pp. 89-91.

Silvestri, A. Bibliografia delle Fusulinidi.—Mem. Pont. Accad. Sci., Nuovi Lincei, vol. XVII, 1933, pp. 523-554.

Todd, J. U. On *Lepidocyclina* (*Lepidocyclina*) *atascaderensis* Berry from the Atascadero Limestone (Eocene) of N. W. Peru.—Geol. Mag., vol. LXX, No. 830, Aug., 1933, pp. 347-351, pl. XVIII. **T.**

Myers, Earl H. Multiple Tests in the Foraminifera.—Proc. Nat. Acad. Sci., vol. 19, No, 10, Oct., 1933, pp. 893-899.

Vaughan, Thomas Wayland. The Biogeographic Relations of the Orbitoid Foraminifera.—l. c., pp. 922-938.

Rutsch, R. Beiträge zur Kenntnis tropisch-amerikanischer Tertiärmollusken. I. Angebliche Rudisten aus dem Tertiär von Trinidad (Brit. Westindien).—Eclogae geologicae Helvetiae, vol. 27, No. 1, 1934, pp. 1-9. **T.**—Mentions foraminifera.

Brotzen, Fritz. Vorläufiger Bericht über eine Foraminiferenfauna aus der schwedischen Schreib Kreide (Mucronatensenon).—Geol. Fören. Förhandl., vol. 56, pt. 1, Jan.-Febr., 1934, pp. 77-80. **C.**—Lists.

Hickson, Sydney J. On *Gypsina plana*, and on the Systematic Position of the Stomatoporoids.—Quart. Journ. Micr. Sci., vol. 76, pt. III, Jan., 1934, pp. 433-480, pls. 26, 27, 13 text figs. **R.**—Discusses structure.

Brotzen, F. Foraminiferen aus dem Senon Palästinas.—Zeitschr. Deutschen Palästina-Vereins, vol. 57, 1934, pp. 28-72, pls. 1-4. **C.**—146 forms noted, 17 new.

Oppl, Egon. Die mikropaläontologische Untersuchung des Salzbohrloches S. 2 bei Troppau.—Verhandl. Naturforschenden Vereines in Brünn, vol. 65, 1934, pp. 27-67, pls. 1, 2. **T.**—Many species listed, 3 new names.

Goudkoff, Paul P. Subsurface Stratigraphy of Kettleman Hills Oil Field, California.—Bull. Amer. Assoc. Petr. Geol., vol. 18, No. 4, April, 1934, pp. 435-475. **T.**—Many references to foraminifera.

Barbat, W. F., and **John Galloway.** San Joaquin Clay, California.—Bull. Amer. Assoc. Petr. Geol., vol. 18, No. 4, April, 1934, pp. 476-499. **T.**—Occurrence of numerous foraminifera noted.

Hadley, Jr., Wade H. Some Tertiary Foraminifera from the North Coast of Cuba.—Bull. Amer. Pal., vol. 20, No. 70A, May 21, 1934, pp. 1-40, pls. 1-5. **T.**—61 species are noted, mostly figured, of which 11 are new, and a new genus *Cibicorbis*.

Morrow, A. L. Foraminifera and Ostracoda from the Upper Cretaceous of Kansas.—Journ. Pal., vol. 8, No. 2, June, 1934, pp. 186-205, pls. 29-31. **C.**—37 species of foraminifera, 25 new.

Thalmann, Hans E. Supplement to Bibliography and Index to Genera and Species of Foraminifera for the Year 1931.—l. c., pp. 238-244.

Secrist, Mark H. Technique for the Recovery of Paleozoic Arenaceous Foraminifera.—l. c., pp. 247-248.

Cullison, James S. A Suitable Tray for Comparative Examination of Minute Opaque Objects under the Binocular Microscope.—l. c., p. 247.

Palmer, Dorothy K. The Foraminiferal Genus *Gümbelina* in the Tertiary of Cuba.—Mem. Soc. Cubana Hist. Nat., vol. VIII, No. 2, July, 1934, pp. 73-76, 8 text figs. **T.**—1 new species, *G. cubensis*.

Bermudez, Pedro J. Un Genero Y Especie Nueva de Foraminiferos Viventes de Cuba.—l. c., pp. 83-86, 3 text figs. **R.**—A new genus, *Palmerinella*, and a new species, *P. palmerae*.

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